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(54) Abstract Title  
Use of coiled tubing and jet drilling to install a casing

(57) A method of installing a conductor pipe 10 or casing 20 in the sea bed 45 comprises lowering the casing or conductor on a length of coiled tubing 30 deployed from a reel on a floating vessel 16. The tubing may extend along the length of the casing and supply pressurised fluid to create a hole ahead of it. Casing may be introduced into the conductor either before or after the conductor has been installed in the sea bed. Also disclosed are accelerometers or gyroscopic sensors 43 (figure 3) mounted on the tubing. These supply positional data that may allow the surface vessel to manoeuvre so as to maintain the tubing in vertical alignment, and also allow the trajectory of the borehole to be traced.

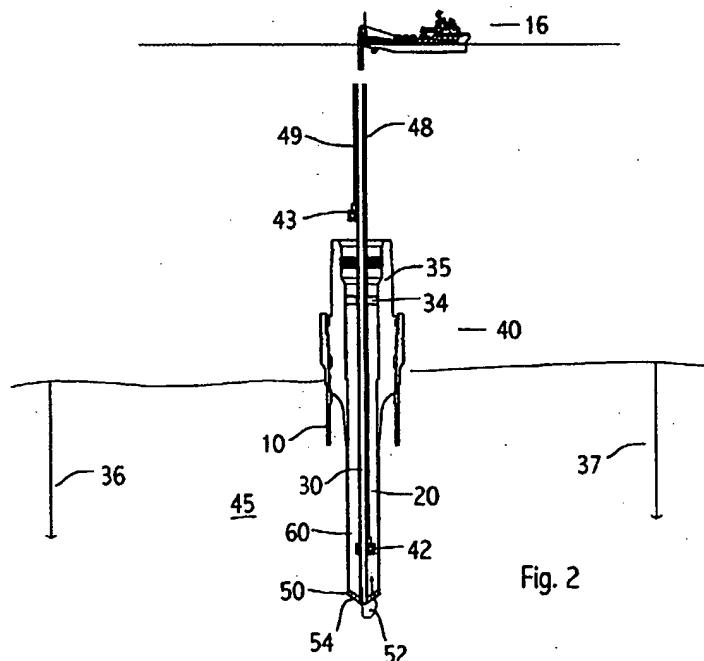


Fig. 2

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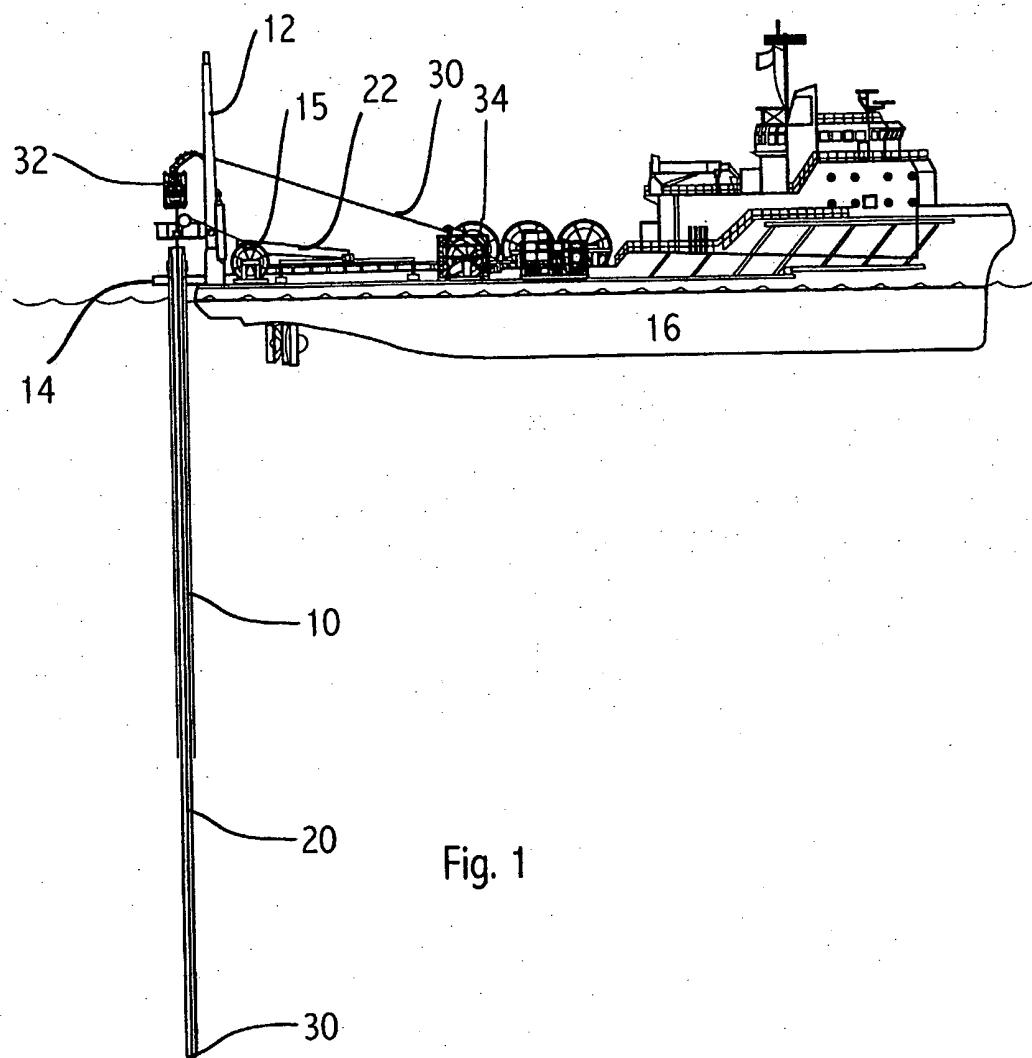
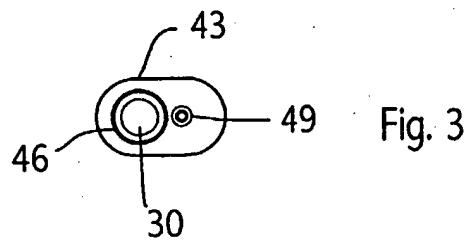
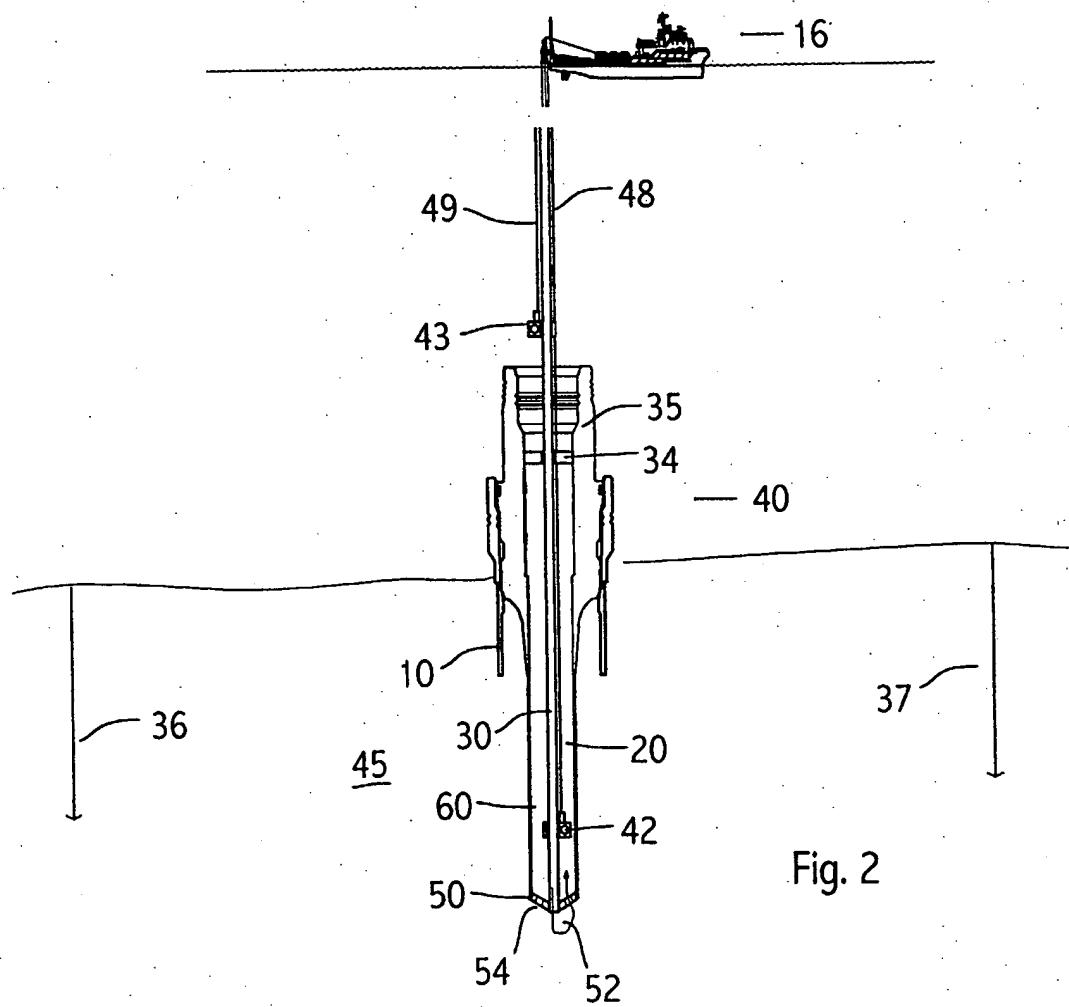


Fig. 1

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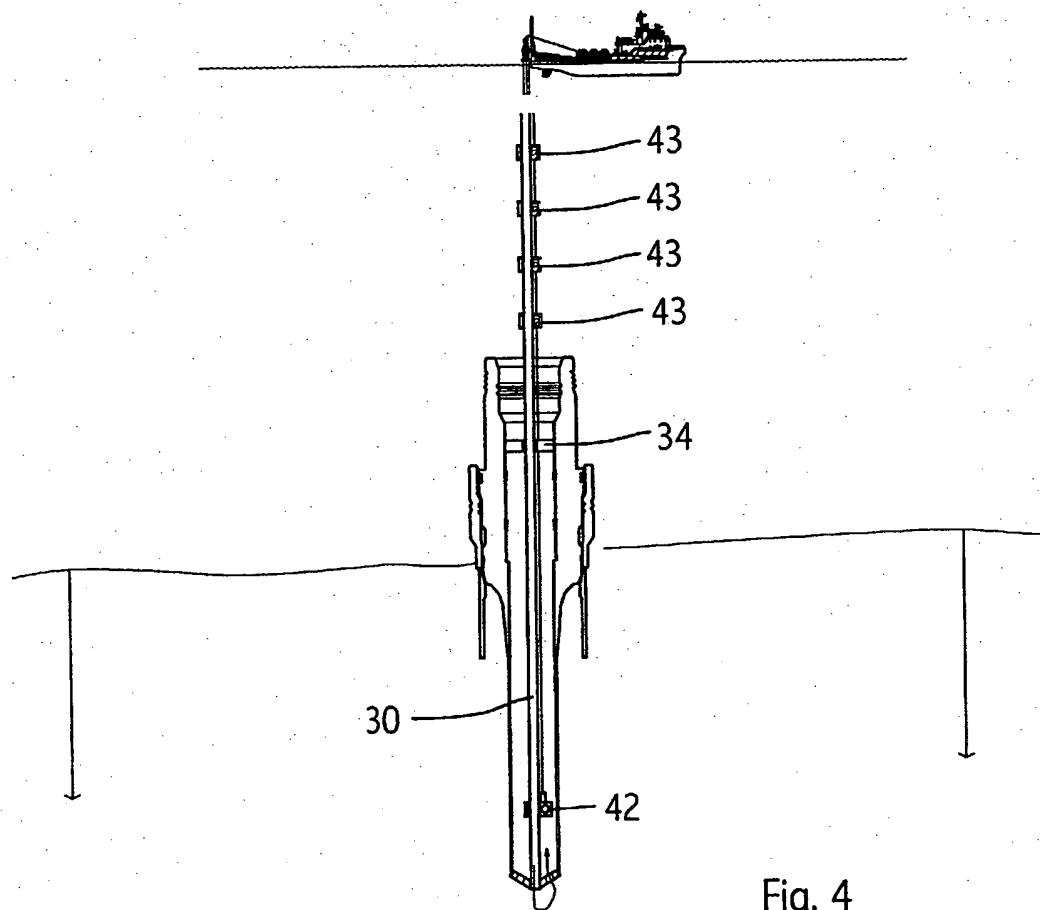


Fig. 4

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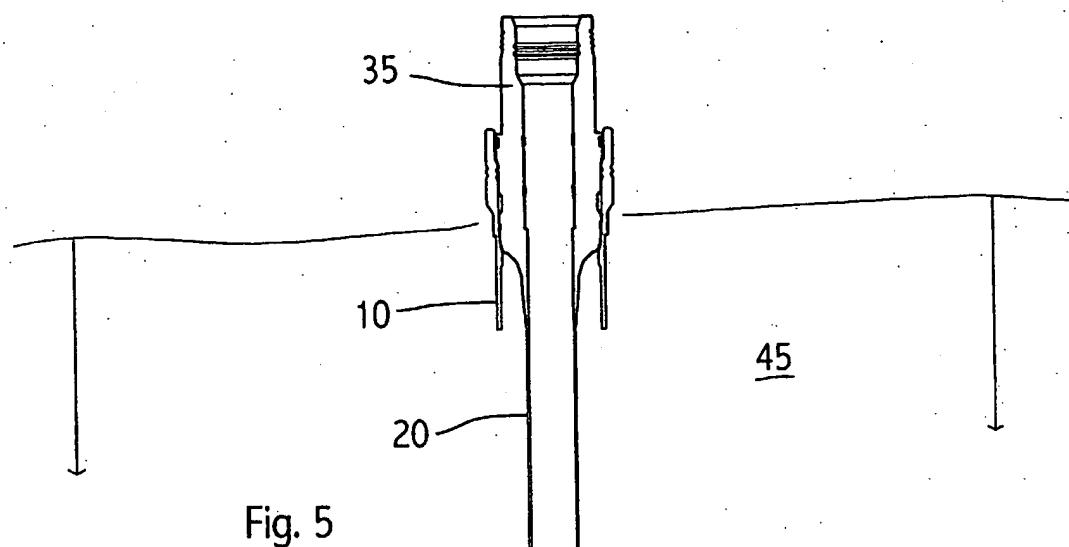


Fig. 5

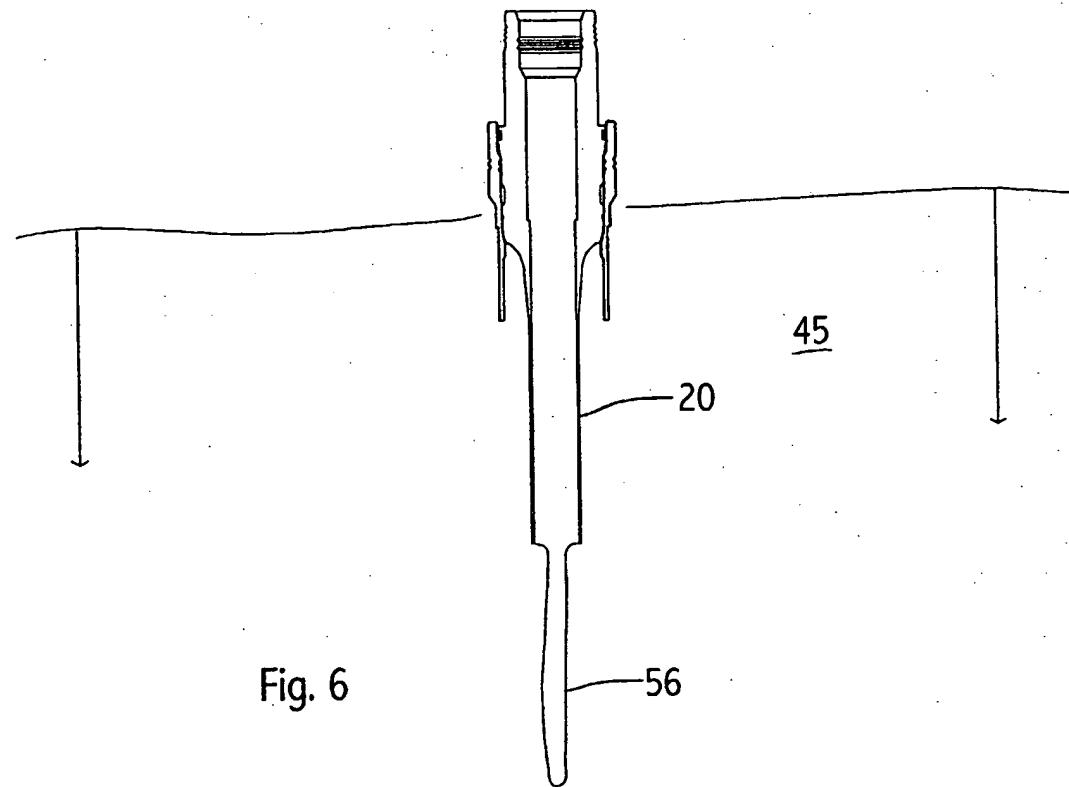


Fig. 6

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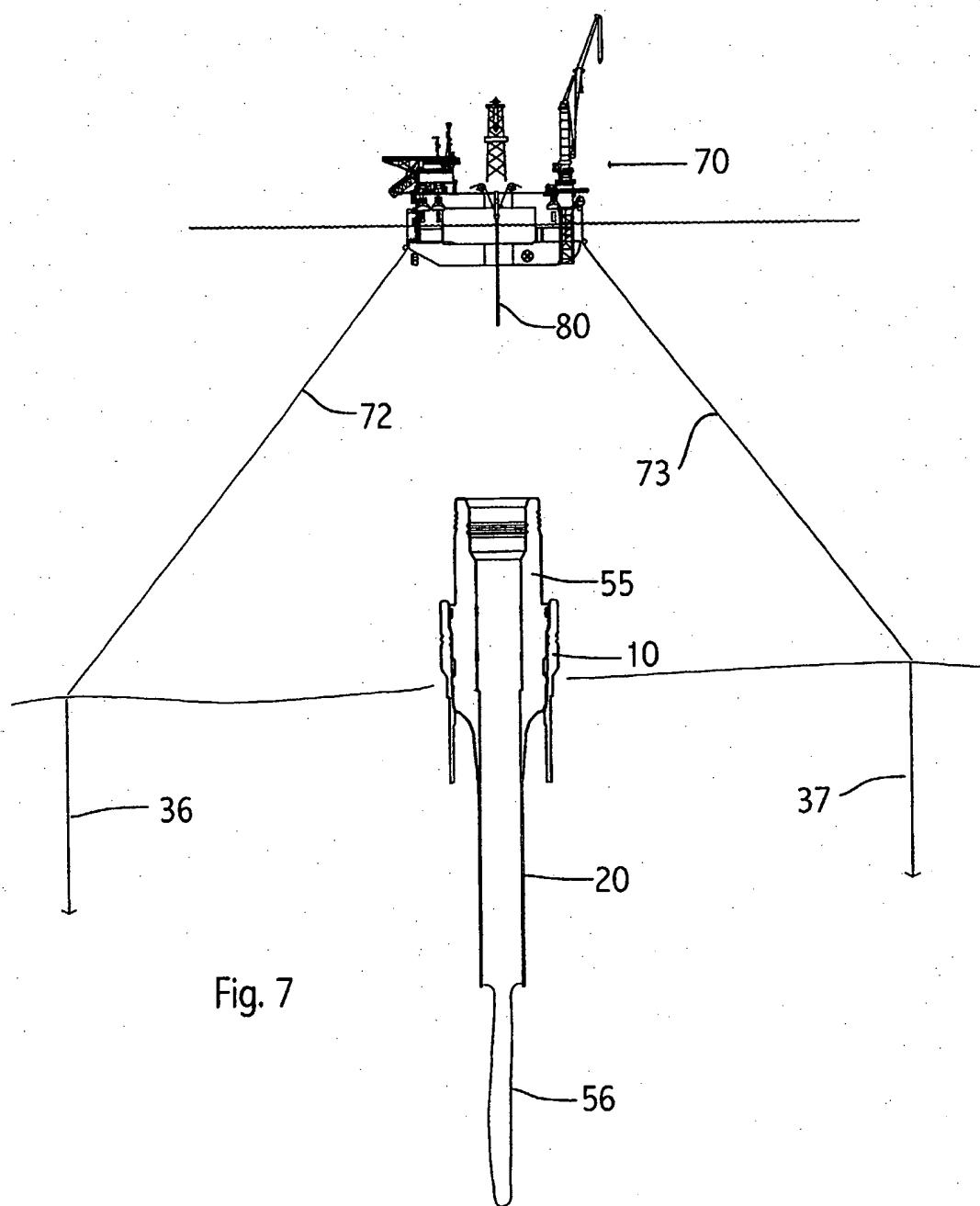


Fig. 7

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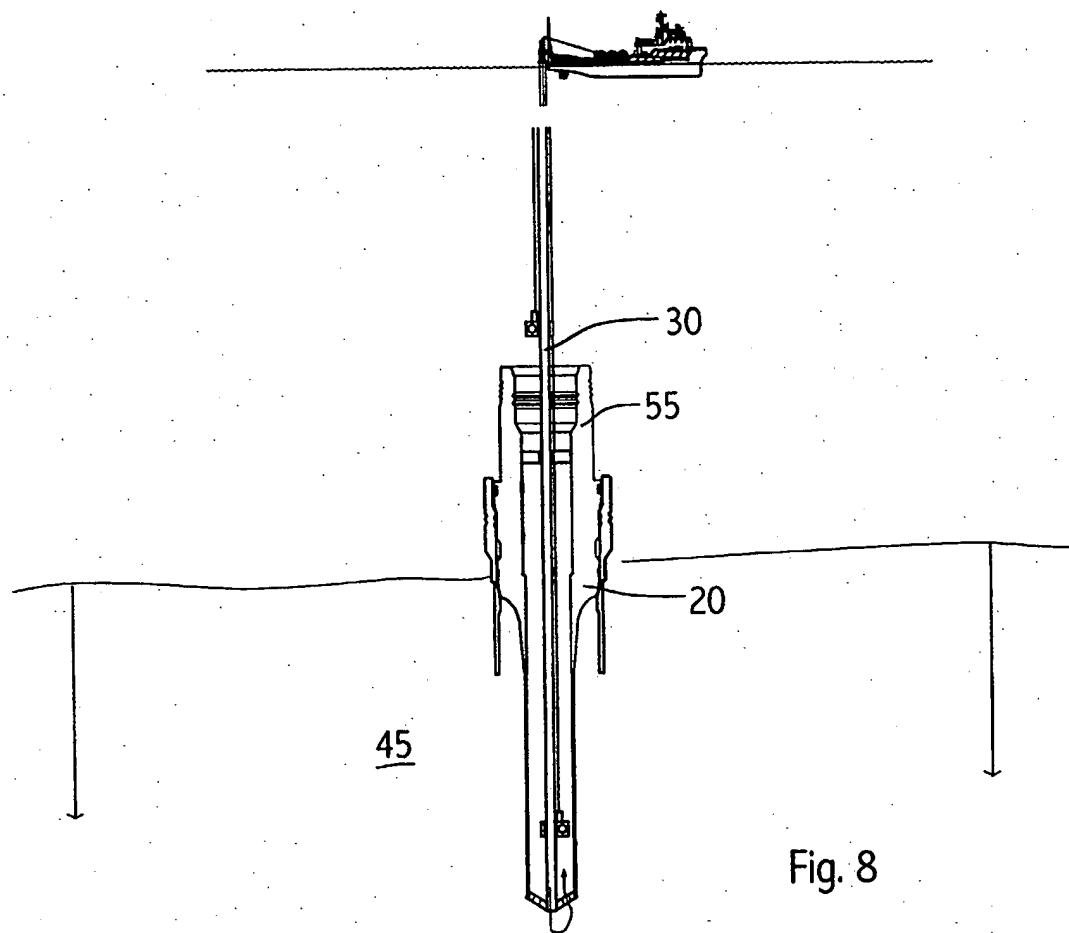


Fig. 8

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### Conductor System

This invention relates to a conductor system, that is, a system including a well conductor which may be installed in the ground, particularly in off shore environments, for the production of oil and gas and associated tasks.

Well conductors are commonly used when drilling in an off shore environment. A well conductor, usually a steel pipe typically 30 inches (0.76 metres) in diameter, is lowered to the sea bed from a derrick on a rig, and is driven into the sea bed, for example by pre-drilling and/or hammering. Sections may be added to the conductor to extend it. A conductor may be lowered several hundred meters into the ground in this way. Adding new sections to the conductor string is obviously cumbersome and time consuming.

It is an object of the present invention to provide a conductor system that may be installed more easily. Other objects of the invention will become apparent from time to time in the description.

According to the present invention there is provided a method of installing a conductor or a casing in the sea bed, the conductor or casing being caused to penetrate the sea bed, characterised in that the conductor or casing is substantially suspended from a length of coiled tubing, the conductor or casing being lowered to the sea bed by means of the coiled tubing.

Preferably the conductor or casing is a conductor deployed in the sea bed at the desired location, and subsequently a casing is introduced into the conductor

5        Alternatively, a casing is introduced into a conductor, substantially suspended from a length of coiled tubing, lowered to the sea bed by means of the coiled tubing, and caused to penetrate the sea bed. Preferably the length of coiled tubing is introduced to the conductor or casing, and preferably extends along the length of the conductor or casing.

10       The penetration may be effected or assisted by fluid being passed through the length of coiled tubing.

15       According to another aspect of the present invention there is provided a method of installing a well conductor or casing in the sea bed, the conductor or casing being caused to penetrate the sea bed, characterised in that there are included sensor means held in proximity to the conductor or casing, such that the sensor means gather data by which means information regarding the position of the conductor or casing may be calculated.

20       Preferably a casing is introduced into a conductor, substantially suspended from a length of coiled tubing, lowered to the sea bed by means of the coiled tubing, and caused to penetrate the sea bed.

25       The sensor means may comprise one or more sensors including gyroscopes.

The invention will now be described, by way of example, reference being made to the accompanying drawings, in which:

5 Figure 1 shows a side view of the system being deployed,

Figure 2 shows a sectional side view of the system during installation,

Figure 3 shows a cross section of a sensor,

10 Figure 4 shows a sectional side view of another embodiment of the system during installation,

Figure 5 shows a sectional side view of the system after installation,

15 Figure 6 shows a sectional side view of the system after installation and a pilot exploration,

Figure 7 shows a sectional side view of the system immediately prior to use,

20 and

Figure 8 shows a section side view of a further embodiment of the system during installation.

The some of the elements present in the figures are schematically represented, being drawn at a different scale to the other elements, or drawn in a foreshortened manner.

5 Referring to figure 1, a well conductor 10 is suspended from a mast 12 and hang off beam 14 located at one end of a ship 16. The well conductor 10 is typically between 80 - 160 feet (18 - 55 metres). A length of casing 20 is introduced into the conductor 10 from a reel (not here shown). The conductor 10 is moved from its storage area, and the casing 20 moved from its storage 10 area and introduced to the conductor, by a conductor/casing handling machine 22. The casing 20 is typically 350 - 500 feet long (106.68 - 152.4 metres), and 13 inches (0.34 metres). The casing 20 being longer than the well conductor 10, the majority of its length extends from beneath the lower end of the conductor. The top of the casing 20 is anchored to the top of the conductor 10. 15 Referring for a moment to figure 2, at the top of the casing is included a wellhead housing 35.

Referring back to figure 1, the length of coiled tubing 30 is introduced by an injector 32 to the casing 20 from a reel 34. The length of the coiled 20 tubing 30 is greater than the length of the casing. The thickness of the coiled tubing is typically 3 1/2 inches (0.089 metres). When the lower end of the coiled tubing 30 reaches the lower end of the casing 20, the coiled tubing is anchored to the top of the casing by a centraliser 43. The centraliser 43 (visible in figure 2) also spaces the coiled tube centrally inside the casing.

Referring to figure 2, the ship 16 is anchored by means of mooring lines (not shown) attached to a number of anchor points 36,37 embedded on the sea bed. The ship may be positioned by adjusting the length and tautness of the mooring lines using the mooring line reels.

5

The conductor 10 is released from the hang off beam 14, and the conductor 10 and casing 20 are lowered by the coiled tubing 30. The coiled tubing 30 is paid out by the injector 32 until its lower end reaches the surface of the sea bed 45. This may be detected by measuring the weight on the coiled tubing, for example. The injector 32 includes heave compensation means so that the coiled tubing system 40 (that is the coiled tubing 30, conductor 10 and casing 20 collectively) is held steadily at the sea bed 45.

Two 'gyro sensors' 42,43 (that is, a sensor containing one or more gyroscopes, and from which orientation may be deduced) are slidably attached to the coiled tubing 30. Referring to figure 3, these sensors 42,43, when considered in section, are approximately annular in form, having a bore 46 through which the coiled tubing 30 may pass. Each sensor is somewhat elongated, with the through bore offset, in order to accommodate the gyroscope and associated circuitry; nevertheless, it is such a size that it may be accommodated within the inner diameter of the coiled tubing. A wireline 48,49 is attached to each sensor, so that it may be raised and lowered to alter its position along the length of the coiled tubing. Referring back to figure 1, the wirelines 48,49 is wound upon a reel 15 for this purpose. Data from the sensors 42,43 are also transmitted along the wireline 48,49 to be analysed on the ship 16. Referring again to figure 2, the upper sensor 43 may thus be

positioned anywhere above the centraliser 34 along the coiled tubing, and the lower sensor 42 may be positioned anywhere below the centraliser 34, so that between them they may provide all the necessary readings by being moved along the length of the coiled tubing.

5

The position of the gyro sensor 42,43 may be determined from its output, in particular giving the inclination of the coiled tubing system 40 from the vertical at a particular point, and the azimuth of the coiled tubing system, the position of the gyro then being calculated by the length of wireline paid out. The lowest point of the coiled tubing system 40 may be vertically below the vessel 16, but the length of the coiled tubing system bowed. The gyro sensors will also give an indication of this.

Generally, the coiled tubing system 40 will not remain vertical as it is lowered, but instead become inclined through the action of currents in the sea. It is highly desirable that the coiled tubing system is installed vertically into the sea bed 45. The ship 16 may be repositioned so that the coiled tubing system is vertical, with continuous readings being taken from the gyro sensors. If bowing is occurring, the coiled tubing 30 may be taken up to reduce slack. It may not be possible to orient the coiled tubing system precisely vertically, and a small inclination may be felt acceptable. The inclination, and the azimuth of the coiled tubing system 40 will be accurately known, whether or not it is decided to reposition the ship. The location of penetration will also be accurately known, as will the path of the bore hole as it is produced, since the gyro sensors may be continuously employed as the coiled tubing system is advanced.

At the lower end of the casing 20 is a jetting member 50, which includes a central jetting aperture 52 with which the lower end of the coiled tubing 30 engages, and inlet apertures 54 which communicate with the annulus 60 between the outer surface of the coiled tubing 30 and the inner surface 20 of the casing.

To advance the coiled tubing system 40 and produce the bore hole, fluid is pumped down the coiled tubing 30, this fluid being emitted from the lower end of the coiled tubing as a jet. The jet of fluid erodes the portion of sea bed underneath it into suspended particles, which are carried with the fluid through the inlet apertures 54 of the jetting member, and up through the casing 20. The coiled tubing 30 is meanwhile paid out, and so advances into the bore hole that it is creating.

15

Referring to figure 4, a number of sensors 43 may be spaced equidistantly above the centraliser 34 along the coiled tubing 30. All the sensors 42,43 are connected to a single wireline 48, so that they may be raised or lowered simultaneously. The distance separating the sensors 43 above the centraliser 34 should ideally be a similar distance to the length of the coiled tubing 30 beneath the centraliser 34, so that the entire length of the coiled tubing may be efficiently covered by the sensors. By using several sensors in this way, the position of the coiled tubing 30 over its entire length may be ascertained more quickly, and its instantaneous position estimated more accurately.

When the bore hole has been advanced and the conductor 10 and casing 20 installed to a satisfactory depth, the centraliser 34 is removed and the coiled tubing 30 is disconnected from the casing, wound back upon the reel, being withdrawn from the casing 20 to leave the casing 20 and the conductor 10 5 embedded in the sea bed, and the wellhead housing 55 exposed as shown in figure 5.

Rather than using sensors containing gyroscopes, similar sensors, such as laser gyroscopes or accelerometers, from which the orientation or position 10 of the coiled tubing system may be calculated, may instead be disposed on the coiled tubing system.

Other sensors could be included in the coiled tubing system, particularly upon the coiled tubing. In this manner, further data about the drilling 15 environment such as coil or rock type, shallow gas, and shallow water flow, so that details of the well design, such as the casing design and the drill type, may be tailored to the site.

Once the casing 20 and conductor 10 have been installed to the correct 20 depth, the centraliser 43 and jetting member 50 could be released from the casing to free the coiled tube 30, and then the coiled tubing could be advanced further into the ground to bore a pilot hole 56 shown in figure 6, and collect further data on the environment beneath the sea bed.

25 Referring to figure 7, since the exact position of the wellhead housing 55 is known, a rig 70 may moored to the previously installed anchor points

36,37, and accurately position vertically above the conductor 10, casing 20 and wellhead housing 55 by adjusting the length and tautness of the mooring lines 72,73. A riser and/or drill string 80 may now be lowered to meet and enter the casing.

5

The principles of the invention disclosed herein could be adapted for different components. Referring to figure 8, the a casing pipe 20 (without a conductor) is suspended from an introduced length of coiled tubing 30 and lowered and installed in the sea bed 45, the casing pipe 20 here terminating in 10 a wellhead housing 55 assembly that is sufficiently robust to not require a conductor. If desired, additional support and guide base means may be added later.

In a similar manner, a length of coiled tubing could be introduced and 15 attached to a conductor pipe (with no casing being included), the conductor being lowered on the coiled tubing and embedded in the ground in a similar manner to that described above. A separate casing means and wellhead housing may then be installed in a later step. Additional components and casings could of course be included.

20

Position transducers, guide lines, or other locating means for allowing a vessel returning after having installed the conductor and casing, or having installed only a conductor, or only a casing, may be included iwith the installed components to help the returning vessel locate and access the installation. 25 These locating means may be used additionally or alternatively to the gro sensors disclosed above.

Other soil penetration means, such as electrically powered or fluid powered drill bits, could be used with the coiled tubing, or used in addition to the fluid jetting described above.

## CLAIMS

1. A method of installing a conductor or a casing in the sea bed, the conductor or casing being caused to penetrate a sea bed, characterised in that the conductor or casing is substantially suspended from a length of coiled tubing, the conductor or casing being lowered to the sea bed by means of the coiled tubing, the coiled tubing being deployed from a reel on a floating vessel.  
5
2. A method according to claim 1, characterised in that the conductor or casing is a conductor deployed in the sea bed at the desired location, and 10 subsequently a casing is introduced into the conductor.
3. A method according to claim 1, characterised in that a casing is introduced into a conductor, the casing and conductor substantially suspended 15 from a length of coiled tubing, lowered to the sea bed by means of the coiled tubing, and caused to penetrate the sea bed.
4. A method according to any previous claim, characterised in that the length of coiled tubing is introduced to the conductor or casing.  
20
5. A method according to any previous claim, characterised in that the length of coiled tubing is introduced to extend along the length of the conductor or casing .

6. A method according to any previous claim, characterised in that the penetration is effected or assisted by fluid being passed through the length of coiled tubing.

5 7. A method according to claim 6, characterised in that the fluid passes through the annulus between the coiled tubing and conductor or casing in the opposite direction to the direction of flow through the coiled tubing.

8. A method according to any previous claim, characterised in that the 10 coiled tubing is disconnected from the conductor or casing after the conductor or casing have been embedded in the sea bed.

9. A method of installing a well conductor or casing in a sea bed, the conductor or casing being caused to penetrate the sea bed, characterised in that 15 there are included sensor means held in proximity to the conductor or casing, such that the sensor means gather data by which means information regarding the position of the conductor or casing may be calculated.

10. A method according to claim 9, characterised in that a casing is 20 introduced into a conductor, substantially suspended from a length of coiled tubing, lowered to the sea bed by means of the coiled tubing, and caused to penetrate the sea bed, the coiled tubing being deployed from a reel on a floating vessel.

25 11. A method according to either claim 9 or claim 10, characterised in that the sensor means comprises one or more sensors including gyroscopes.

12. A method according to any of claims 9 to 11 characterised in that the sensor means are moveable relative to the conductor and/or casing along at least part of the length of the conductor and/or casing.

5

13. A method according to any of claims 9 to 12 characterised in that a length of coiled tubing is introduced to the casing and the sensor means are deployed on the coiled tubing.

10

14. A coiled tubing system comprising a conductor and/or casing and length of coiled tubing according to any previous claim.

15. A method of installing a conductor and/or casing substantially as herein described and illustrated.

15

16. A coiled tubing system substantially as herein described.

17. Any novel and inventive feature or combination of features specifically disclosed herein within the meaning of Article 4H of the International

20 Convention (Paris Convention).



Application No: GB 0104771.1  
Claims searched: 1-17

Examiner: Andrew Hughes  
Date of search: 18 February 2002

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): E1F FBA

Int Cl (Ed.7): E21B 7/12, 7/18, 7/20

Other: Online: EPODOC, WPI & JAPIO

**Documents considered to be relevant:**

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2133060 A	(CANOCEAN RESOURCES) particularly figure 1	5
X, Y	GB 1228247 A	(INSTITUT FRANCAIS DU PETROLE) particularly figure 1 and page 4	X: 1, 4, 6-8 Y: 2, 5
Y	GB 1200066 A	(TEXACO DEVELOPMENT) whole document	2, 5
Y	GB 1029729 A	(TEXACO DEVELOPMENT) whole document	5
Y	US 5291956 A	(UNION OIL) particularly figure 1	2, 5

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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